Results:

	AMI Se	IMI Se	NSp	LSp	OSp
GP	76%	69%	100%	93%	99%
GP + NN + M	78%	88%	100%	85%	97%

Se = sensitivity, Sp = specificity, N = normal, L = LVH, O = overall

Conclusions: This first report of neural networks for the diagnosis of myocardial infarction embedded within a deterministic logic program has shown that (1) the technique significantly improves the diagnosis of inferior though not anterior MI; (2) the evaluation of specificity using only normals is misleading; (3) the technique can usefully be adopted selectively to enhance diagnostic ECG programs in future.

2:30

759-3 Prediction Models for Outcome of Coronary Surgery and Coronary Angioplasty on a Desktop

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There is a need in clinical practice for rapid accessibility of outcome data in rapid fashion for clinical decision making. Data for this purpose come largely from clinical trials and databases. Emory University has a cardiovascular database with 80,000 patients which includes all cardiovascular surgical procedures and interventional procedures in the coronaries since 1972. Querying the database to examine outcome is practical for research, but limited as a clinical tool. Thus, the data in the database are largely accessible through published datasets and prediction models. These prediction models have been reflected in a computer program that may run on a personal computer. In hospital outcomes are predicted by stepwise logistic regression and long term outcome (time-to-event) by Cox model analysis. Mean survival curves for the Cox model are needed as well as the coefficients. The data for survival curves is stored in an Access 2.0 database. The primary application is programmed in Visual Basic 3.0 and will run on any IBM PC or clone running DOS 5.0 or higher and Windows 3.0 or higher. The application uses a full graphical user interface. The in-hospital outcome data are expressed as percentages. Survival (time-to-event) data are expressed as survival curves. The entire application is mouse controlled and there is no typing at any time. The user starts the program from a windows icon and then a main menu offers a selection of models. The user clicks on a model. Then a specific screen for the model appears and the user selects values for the correlates of the endpoint. When done the user clicks for the data to be displayed. Movement within models and between models is straight forward, simple and fast. The current models after coronary surgery: in hospital death, Q wave myocardial infarction, stroke, death after reoperative surgery, long term survival, non-fatal events and survival after reoperative surgery. The current models after angioplasty: in hospital death, Q wave myocardial infarction, emergency surgery, restenosis, long term survival and long term cardiac events. Clinical cardiologists and cardiology fellows can learn to use the program essentially immediately, without training. Clinical understanding and proper use of the tool are the limitation as the computer application has been simplified as much as possible.

2:45

759-4 Information Integration for Cardiology Decision Support

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Electronic medical records pose a challenge because of the complex types of data which are included. Decision support systems must be able to deal effectively with these data types. In the expert system demonstrated here, a diversity of data types are included. These data are processed by three different methods. However, the different methods of processing are transparent to the user. An overall rule-based interface integrates the different methods into one comprehensive system. Data types include crisp data, fuzzy data, temporal data, and numerical representation of chaotic analysis. Some data items which appear to be crisp, for example, test results, are more accurately represented as fuzzy numbers which indicate the degree of precision of the test. Four types of temporal data are considered: change in value from previous value, change in value relative to a specified time interval, duration data, and sequence data. A measure developed by the authors which determines the degree of variability in time series data is also included. The knowledge-based portion of the system utilizes approximate reasoning techniques which allows weighting of antecedents and partial presence of symptoms. The rule base is used as the interface which invokes a neural network model or time series analysis if certain rules are substantiated. The neural network model is a three-level feed-forward model based on a non-statistical learning supervised learning algorithm developed by the authors. Input data can be of any ordered form, including binary, categoric, integer, or continuous. The network can categorize data into two or more classes, and also produces a degree of membership for each class. Time series data, such as electrocardiograms, are important measurements for many diagnoses. An ECG may have an overall interpretation which can be used in the rule-based component, or categorized to be used in the neural network component. However, other analyses may also prove useful. In the application shown, a measure of variability for 24-hour Holter tapes is used. The combination of these techniques is illustration in a decision support system for the diagnosis and treatment of heart disease, including the use of a rule base, a supplementary neural network model of exercise testing data (ETT), and a time series analysis for Holter data.

3:00

759-5 Use of an Interactive Electronic Whiteboard to Teach Clinical Cardiology Decision Analysis to Medical Students

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We used innovative state-of-the-art computer and collaboration technologies to teach first-year medical students an analytic methodology to solve difficult clinical cardiology problems to make informed medical decisions. Clinical examples included the decision to administer thrombolytic therapy considering the risk of hemorrhagic stroke, and activity recommendations for athletes at risk for sudden death. Students received instruction on the decision-analytic approach which integrates pathophysiology, treatment efficacy, diagnostic test interpretation, health outcomes, patient preferences, and cost-effectiveness into a decision-analytic model.

The traditional environment of a small group and blackboard was significantly enhanced by using an electronic whiteboard, the Xerox LiveBoard™. The LiveBoard features an 80486-based personal computer, large (3' × 4') display, and wireless pens for input. It allowed the integration of decision-analytic software, statistical software, digital slides, and additional media. We developed TIDAL (Team Interactive Decision Analysis in the Large-screen environment), a software package to interactively construct decision trees, calculate expected utilities, and perform one- and two-way sensitivity analyses using pen and gesture inputs. The LiveBoard also allowed the novel incorporation of Gambler, a utility assessment program obtained from the New England Medical Center. Gambler was used to obtain utilities for outcomes such as non-disabling hemorrhagic stroke. The interactive nature of the LiveBoard allowed real-time decision model development by the class, followed by instantaneous calculation of expected utilities and sensitivity analyses. The multimedia aspect and interactivity were conducive to extensive class participation.

Ten out of eleven students wanted decision-analytic software available for use during their clinical years and all students would recommend the course to next year's students. We plan to experiment with the electronic collaboration features of this technology and allow groups separated by time or space to collaborate on decisions and explore the models created.

3:15

759-6 Computerization of the ACC/AHA Guidelines for PTCA and CABG — Use of a Relational Database for Comparison with RAND Expert Panel Ratings and University of Maryland Revascularization Appropriateness Scores (RAS)

Michael A. Lauer, Andrew A. Ziskind, Cynthia C. Lemmon, Robert A. Vogel. *University of Maryland, Baltimore, Maryland*

With the increased emphasis on determining the need for coronary revascularization, appropriateness scoring systems have been developed. We developed software to apply clinically the complex ACC/AHA Guidelines for PTCA (1993) and CABG (1991).

Using 4D on an Apple Macintosh, we designed a relational patient database which captures key clinical information: patient demographics, clinical presentation, medications, comorbidity, exercise test results, left ventricular function, angiographic data, and followup events. Compiled code automatically assigns the patient to the proper clinical subsection, interprets relevant coronary anatomy and calculates the appropriateness classification — Class I (general agreement with indication), Class II (divergence of opinion), and Class III (general agreement that procedure is not indicated). In addition to providing objective appropriateness scores using the ACC/AHA PTCA and CABG Guidelines, the system automatically compares those scores with RAND Expert Panel Ratings and the University of Maryland RAS.

Reports can be produced based on specified search criteria for an individual patient or an entire patient group, thus allowing analysis of patterns of